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ABSTRACT

The evidence for the construct validity of classroom climate measures was examined within a theoretical model where several affective measures served as criterion variables. The patterns of social-psychological and management-organization structural dimensions differed when the unit of analysis varied from the individual to the class. The structural dimensions were also shown to vary as a function of mathematics, science and social studies subjects, but not as a function of the seventh and ninth grade levels. Factor analyses of 15 classroom variables were made for each subject and each analysis unit in five rotations, and were correlated to the outcome variables of student attitude toward the subject matter and teacher quality. Guidelines are offered for validation studies where the unit of analysis may vary and the interpretability of the psychometric measures are discussed. (Author/CM)

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Validity of Classroom Climate Measures as a Function of the Unit of Analysis and Sample

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ABSTRACT

Validity of Classroom Climate Measures as a
Function of the Unit of Analysis and Sample

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The purpose of this study was to examine the evidence for the construct validity of classroom climate measures from the perspective of a theoretical model where several affective measures served as criterion variables. The model was tested at two units of analysis for various sample conditions across two grade levels. Patterns of structural dimensions differed when the unit of analysis varied from the individual to the class. These patterns varied also as a function of the subject matter being studied but not as a function of the grade level. Guidelines are offered for validation studies where the unit of analysis may vary.

A paper presented at the Annual Meeting of the National Council on Measurement in Education, New York, March, 1982.

Validity of Classroom Climate Measures as a
Function of the Unit of Analysis and Sample

There has been an increasing interest in classroom climate measures over the past decade (Epstein, 1981; Moos & David, 1981; Walberg, 1974). Two reasons for this increase are: (a) that functional relationships have been shown to exist between learning environment variables and achievement (Walberg, 1980); and (b) some of these variables are also important school outcomes. Among these environmental variables which serve as outcomes are student motivation factors such as attitude toward the subject matter, academic self-concept, importance of the subject matter, apathy, satisfaction, and attentiveness.

An analysis of these outcome variables should reveal that teacher quality and the classroom climate are important determinants of these outcomes, and there is recent progress on the problem of formulating and determining the relationship of each of the many classroom climate variables on school learning and these affective outcomes (Haladyna & Shaughnessy, in press, a & b).

A common problem faced by many researchers, according to Sirotnik (1980), is a failure to consider the psychometric phase of research. This statement is based on the belief that any study is only as good as its data. A psychometric consequence in any research is the unit of analysis. Not only is the consequence different when the unit of analysis varies from the individual to the class or a larger group, but our interpretation of test scores varies as well. Since the essence of construct validity is the meaning of measurements, or our interpretations of these measurements, then it seems important to consider, as Sirtonik (1980) suggests, what we hope to measure and why?

To answer that second question, a measurement may be useful as part of a research study, the measurement represents one of our dependent or

independent variables, and Messick (1975) among others would argue that these measurements should be construct referenced. In a more practical context, school systems are increasingly desiring to examine school outcomes of instructional programs. Consequently the psychometric study of measurements is also important for obvious reasons: school improvement efforts need to focus on measurable causes of school outcomes.

The answer to the first question posed above can be found in the definition of the constructs to be measured and the instruments we use to measure the constructs. This implies that some preliminary work has been done to conceptualize the construct and that attempts have been made to map these abstractions into observables in the form of some instrumentation.

The present study focuses on structural dimensions of two aspects of the classroom climate, the social-psychological and the management-organizational, relative to a theoretical model where each of these and teacher quality are believed to affect student motivation. The specific questions addressed in the study were:

1. How do structural dimensions of the classroom climate vary as a function of the unit of analysis and the sample?

2. What implications do these variations have for construct interpretations?

METHOD

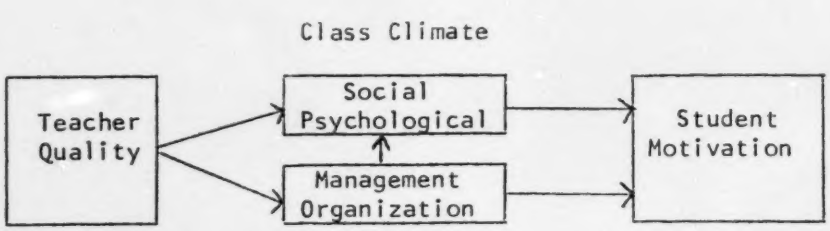
The data base for the study comes from a research project sponsored by the National Science Foundation involving nearly 200 junior high and high school teachers and their classrooms which were distributed across grades seven and nine in the subject matters of mathematics, science, and social studies. The students were administered a self-report inventory covering: (a) basic demographics; (b) family and home influences; (c) attitudes toward school and seven subject matters; (d) 15 classroom climate variables from the Learning Environment Inventory and the Class

Environment Scales; (e) indicators of teacher quality; and (f) student motivational variables. The class climate variables were the focus of this study (see Table 1).

The reliability of measures at individual and class units of analysis is known to vary substantially. Individual scores tend to have low reliabilities ranging from .30 to .70 using alpha to estimate reliability, while class means have substantially higher reliabilities. The variability of class means is also restricted when compared to individual scores, which range from the ceiling to the floor of each scale. Further information about the psychometric characteristics of these measures may be obtained from Haladyna and Shaughnessy (1982).

Two units of analysis were considered: the class and the individual. Also considered was the grade level (seven and nine) and three subject matter areas (mathematics, science, and social studies).

There was an interest in the factorial structure of the 15 classroom climate variables as well as in the predictive validity of these measures on selected outcomes measures. The general form of the causal implications of the model is expressed below:



Two kinds of analyses were conducted. First, factor analysis was attempted for each subject matter and for each unit of analysis. A principal component was followed by five different rotations: varimax, equamax, quartimax, and two variations of an oblique solution. While a two-factor solution was expected, each of these rotations have different conditions which may more effectively detect factors, and allowances were made for the detection of additional factors. Generally, significant

Table 1

Learning Environment Measures
and Sample Items from Each

Social Psychological

1. School Environment--Kids like this school.
2. Enjoyment of Classmates--How much do you like the students in this class.
3. Cohesiveness--Most students know each other very well.
4. Class Environment--The students would be proud to show this classroom to a visitor.
5. Friction--There is a group of students that interfere with class activities.
6. Speed--The class has plenty of time to cover the assigned work.
7. Cliqueness--Certain students stick together in small groups.

Management-Organization

1. Formality--Students are asked to follow strict rules.
2. Competition--Students don't compete with each other here.
3. Goal Direction--Most students know the goals of the course.
4. Organization--The class is well organized.
5. Difficulty--Most students consider this subject matter easy.
6. Diversity--What students do in class is very different on different days.
7. Materials Usage--We have good materials to read for this class.

factors had to have eigenvalues of over 1.00. All climate variables were correlated to two outcome variables, student attitude toward the subject matter and teacher quality for each subject matter and unit of analysis.

RESULTS AND DISCUSSION

Factor Analysis

For the most part, the varimax rotation provided the clearest resolution of the hypothesized results. Table 2 contains the results of the factor analysis of individual scores. As shown there, six variables consistently loaded on the management/organization factor: competiveness, goal direction, organization, difficulty, diversity, and materials usage. It should be pointed out that difficulty should be interpreted as classes which appear easier are also more competitive, goal directed, and better organized.

Other results reported in Table 2 indicate six variables as consistently loading on the social/psychological factor: school environment, enjoyment of classmates, cohesiveness, class environment, friction, cliqueness, and speed. The friction and cliqueness factors are negative and should be interpreted as negatively related to the others. Speed (pace of instruction) is a curious finding in that category and appears better suited for management-organization. Nonetheless this result was replicated across all three conditions, each with sizable samples.

The resolution of factors for class means was an altogether different state of affairs. Remembering that class means tend to be more reliable but that the sample sizes are necessarily smaller, we are analyzing samples of 72, 64 and 55 for mathematics, science, and social studies. The results of the factor analyses are reported in Table 3.

Unlike the results for individuals, factor structures for class means were more complex and varied from subject to subject. The analysis

Table 2

Factor Headings For Variables[1] Hypothesized Represent Two Climate Constructs

Management/Organization	Mathematics N=1496	Science N=1317	Social Studies N=1159	Total N=3972
Competitiveness	76	71	75	74
Goal Direction	61	62	65	64
Organization	80	68	76	76
Difficulty	64	67	75	68
Diversity	79	80	75	78
Materials Usage	78	78	76	77
Social/Psychological				
School Environment	81	83	82	82
Enjoyment of Classmates	73	77	75	73
Cohesiveness	72	77	72	73
Class Environment				
Friction	50	58	47	50
Cliqueness	73	76	75	75
Speed	72	75	65	71

[1] decimals omitted

Table 3

Factor Analysis of Class Means for Each of Three Subject Matters

Mathematics (n=72)

Organizational Climate		Social Climate		Pace of Instruction		Formality	
1. Cliqueness	.87	1. Cohesiveness	.92	1. Speed	.76	1. Formality	.91
2. Organization	.85	2. Enjoyment of Classmates	.62	2. Difficulty	-.80	2. Favoritism	.70
3. Friction	-.82	3. Class Environment	.54				
4. Goal Direction	.74						
5. School Environment	.56						

Diversity of Instruction	
1. Diversity	.90
2. Materials Usage	.50

Science (n=64)

Organizational Climate		Diversity of Environment		Instructional Variety		Pace of Instruction	
1. Friction	.84	1. Diversity	.82	1. Cohesiveness	.83	1. Difficulty	-.89
2. Cliqueness	.80	2. Class Environment	.74	2. Goal Direction	.55	2. Speed	.59
3. Favoritism	-.74	3. Enjoyment of Classmates	.69	3. Materials Usage	.41		
4. Organization	.66						

Social Studies (n=55)

Organizational Climate		Diversity of Environment		Pace of Instruction		Formality	
1. Friction	-.83	1. Diversity	.83	1. Difficulty	-.86	1. Formality	.84
2. Cliqueness	-.83	2. Materials Usage	.66	2. Speed	.82	2. Competitiveness	.65
3. Organization	.75	3. Classroom Environment	.64				
4. Goal Direction	.60	4. Enjoyment of Classmates	.58				
5. Favoritism	-.51						

of all class means, across all three subjects was unproductive regardless of the method of rotation. The results shown in Table 3 would indicate five distinct factors for mathematics: (1) organizational climate; (2) social climate; (3) pace of instruction; (4) formality; and (5) diversity of instruction. In science, this factor structure was partially replicated but clearly different in many ways. Organizational climate had fewer members; social climate disappeared and was replaced by diversity of the environment; pace of instruction was replicated; but instructional variety was a mongrel factor of dubious interpretability. With social studies, much of the same results reported for science appeared again. Two factors that appeared consistently were organizational climate and pace of instruction. Diversity appeared to lead factors for each subject matter but the supporting members changed as a function of the subject matter. In mathematics, materials usage joined diversity; in science diversity was accompanied by class environment and enjoyment of classmates; and in social studies diversity was joined by materials usage, class environment, and enjoyment of classmates.

A conservative researcher might be persuaded to organize these 15 classroom climate variables into several constructs, but each one would only have a few variables. A reconceptualization might result in the following:

Organizational Climate	Pace of Instruction	Diversity	Social Climate
1. Cliqueness	1. Speed	1. Diversity	1. Cohesiveness
2. Organization	2. Difficulty	2. Materials Usage	2. Enjoyment of Classmates
3. Friction			3. Class Environment
4. Goal Direction			

Four variables have been dropped. These are school environment, formality, competitiveness, and favoritism. These may be retained as individual constructs or simply removed, depending upon the purpose of the study. More will be said about this plight later.

Relationships to Outcome Variables

One goal in validation as well as in research is to establish relationships between constructs of interest. In the present context, validation, there is an advantage in knowing which variables are predictive of important outcome variables and which are not. For instance, in school assessment, economy of assessment might be achieved by eliminating variables which are known to be uncorrelated with outcome variables. The problem is complicated by differences that may arise from the unit of analysis or the subject matter being studied. Tables 4 and 5 provide correlations between classroom climate measures and two outcome variables, attitude toward the subject matter and teacher quality, both of which can be found in the model briefly outlined earlier and discussed in further detail in other sources. As noted in each table, great differences consistently occur between a correlation based on a class mean and a correlation based on individual student scores. The differences range considerably without any predictable pattern, over .30 to as little as .07. Certain variables appear to be strongly related to an outcome variable, regardless of subject matter or unit of analysis: enjoyment of classmates, class environment, speed, organization, and materials usage. Other variables appear sporadically in terms of strength of association across these conditions.

Two conclusions appear in order here: (1) the unit of analysis appears to have a significant and differential effect on the size of the relationship as class means correlations consistently tend to be higher: (2) there are small and consistent subject matter-to-subject matter differences but not serious enough to consider when considering these variables for inclusion or exclusion in a study or school assessment. That is, inter-subject differences for a class mean correlation or an individuals correlation do not appear to be very great.

Table 4

Relationships of Class Climate Variables
to Attitude Toward the Subject Matter
Across Two Units of
Analysis and Three Subject Matters

	Mathematics		Science		Social Studies	
Social-Psychological	Class	Ind.	Class	Ind.	Class	Ind.
1. School Environment	48	27	30	25	38	28
2. Enjoyment of Classmates	68	38	62	32	58	38
3. Cohesiveness	32	16	42	13	33	16
4. Class Environment	65	35	70	40	64	34
5. Friction	-36	-11	-26	-14	-39	-11
6. Speed	39	26	40	28	50	29
7. Cliqueness	27	11	37	17	14	13
Management-Organization						
1. Formality	-24	-13	-07	-08	-33	-12
2. Competitiveness	34	09	20	-06	38	11
3. Goal Direction	52	16	57	22	59	23
4. Disorganization	57	32	56	31	61	31
5. Difficulty	09	-04	-19	-13	-16	-10
6. Diversity	45	18	69	21	49	14
7. Materials Usage	63	29	55	30	62	34
8. Favoritism	-39	-17	-27	-18	-10	-06

Table 5

Relationships of Class Climate Variables
to Teacher Quality Across Two Units
of Analysis and Three Subject Matters

	Mathematics		Science		Social Studies	
Social-Psychological	Class	Ind.	Class	Ind.	Class	Ind.
1. School Environment	55	45	40	46	36	44
2. Enjoyment of Classmates	71	50	76	46	70	47
3. Cohesiveness	25	21	40	25	36	24
4. Class Environment	71	49	77	57	67	53
5. Friction	-57	-22	-50	-24	-45	-19
6. Speed	41	34	44	30	48	38
7. Cliqueness	34	15	50	25	30	18
Management-Organization						
1. Formality	-24	-11	-20	-14	-38	-11
2. Competitiveness	37	16	31	13	42	19
3. Goal Direction	57	30	68	38	78	42
4. Organization	68	52	74	55	75	55
5. Difficulty	17	-04	-26	-17	-25	-15
6. Diversity	53	26	70	34	60	33
7. Materials Usage	69	45	65	48	73	48
8. Favoritism	-40	-24	-48	-32	-11	-17

Interpretability

While the present study has shown some clear psychometric differences as a function of the unit of analysis and subject matters, the study has not addressed the interpretability of such measures in research or for school assessment.

In his fine paper on the subject, Sirotnik (1980) makes it clear that our interpretations of class means is conceptually different from interpretations of individuals. The essence of the individual vs. the class mean issue is summarized:

> The group was often selected as the unit when the constructs were viewed as "organizational" in nature and the individual within a single organization when the constructs were viewed as "psychological" in nature (Sirotnik, 1980, p. 256).

Therefore, any researcher or school evaluator should matter-of-factly ask the question: What is the purpose in the measurement, to uncover factors which deal with the organization and conduct of instruction or to deal with factors that psychologically affect the student? It would seem that in most studies of school effectiveness, teaching, and causal determinants of learning, the class mean is a better choice as the unit of analysis for the following reasons:

1. The class mean is closer in concept to the meaning of the organizational nature of the phenomenon being studied;
2. Class means are more reliable, being aggregates of less reliable individual scores;
3. Class means have higher predictive validity;
4. Most school programs for improvement of instruction seemed geared to deal with groups of students as opposed to individuals and are more likely to organize staff development and curriculum efforts to affect classes as opposed to individuals.

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